Abstract: Ever since the 1972 Stockholm UN conference on the human environment, which established the nexus between underdevelopment and environmental integrity, environmental issues have become transnational. Environmental degradation is real and its effects are exceedingly deleterious on man. Awareness has been generated on the devastating impact of uncontrolled exploitation of environmental resources. Researchers have equally showed that most of the changes in the environment are the natural consequences of certain selfish exploitative activities of man. The threat to wild-life, ecosystem, fauna and flora and indeed the security of the human race has created policies and organizations whose primary goals and objectives are the protection and preservation of the environment. Environmental Impact Assessment is the perceived tool for achieving the desired balance. Nigeria is one of the few developing countries that have specific relevant legislation and therefore this paper examines EIA as an environmental management tool to bitumen exploration in Nigeria.

Keyword: Environment, Degradation, Environmental Impact Assessment, Bitumen
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provided by the project proponent to inform the public, government agencies and decision-makers about the proponent’s understanding of the consequences of their project. The information provided during the process allows early consideration of the project’s place in the overall plan for the nation’s environment and economy. Bitumen is a mixture of organic liquids that are highly viscous, black, sticky, entirely soluble in carbon disulfide and composed primarily of highly condensed polycyclic aromatic hydrocarbons. Naturally occurring crude bitumen is a sticky, tar-like form of petroleum which is so thick and heavy that it must be heated or diluted before it will flow. At room temperature, it has a consistency much like cold molasses. Refined bitumen is the residual fraction obtained by fractional distillation of crude oil. It is the heaviest fraction and the one with the highest boiling point, boiling at 525°C (977°F). The difference between bitumen and crude oil is the physical state of existence and impurity of mineral contents at reservoir conditions. Thus, the major differentiating properties between bitumen and the conventional light crude are fluid viscosity, reservoir pressure and residual saturation, all of which affect mobility of the resources. Whereas conventional crude is liquid at reservoir conditions, bitumen can be a hard solid, a soft mass, a paste or sludge (also called heavy oil at this state). It is these differences in conditions at the points of occurrence that necessitate the differences in the recovery methods employed for crude oil and bitumen being governed under mining regulations, while crude oil is governed under petroleum regulations in most countries such as Nigeria where the two resources are found. However, even in such countries, the producers of light oil and bitumen mostly come together under the same associations of petroleum producers. It is also common to find the same companies producing bitumen and crude oil. This is due mainly to the close similarities and even confluence in the exploration, midstream and downstream operations in these two industries. It is now obvious from the above background that many of the environmental issues in the crude oil sector will also be found in the bitumen sector. However, the recovery of bitumen may have more far reaching environmental impacts depending on the technology employed.

Nigeria Bitumen Deposit

Bitumen occurrence was first reported in Nigeria in 1900 and the exploration for bitumen in Nigeria began as far back as 1905 when Mineral Survey of southern Nigeria drilled shallow boreholes in the western most part of a line of oil known as the tar sand belt. Currently, over one hundred exploration boreholes have been sunk throughout the bitumen belt since the 1900’s and about forty (40) more boreholes are being planned for the year 2006. The Nigerian bitumen deposit put at 42.74 billion metric
tons is the second largest in the world and was first discovered in 1900\textsuperscript{[3]}. It covers 120 kilometers coastal belts of Lagos, Ogun, Ondo and Edo states. Extensive bituminous seepages and sediments impregnated with tarry oil define a narrow band about 5-8km wide between latitude 60°37’N and 60°48’N stretching from just east of Ijebu-ode town (Ogun State) to the banks of the tributaries of the Siluko River at Ofosu Village in Edo State, an approximate distance of 110km\textsuperscript{[2],[19]}. It is covered by the following Federal Survey sheets 280, 280A, 281, 281A, 282 and 283. They occur in two different forms: (i) as seepages in farmlands (seen only on hot days) from the underlying sandstone reservoir. (ii) As surface and near surface impregnated sediments exposed along road cuts, cliff faces and river banks and at break of slopes with the exception of road cut exposures, most of these seepages and surface/near surface impregnated sediments occur in geographic positions not easily accessible. Sub-surface occurrences of bituminous sands and heavy oils are known from flows and shows in drilled and cored wells in the onshore, coastal and offshore areas of the basin. Most of these wells (now abandoned) penetrated horizons with highly viscous hydrocarbons at relatively shallow depths.

**The Bitumen Process**

The bitumen process involves exploration, mineral recovery, extraction and upgrading. Support activities include transportation, storage and utilities. Products marketing and administration do have environmental impacts but these are not in the same magnitude as those from the core activities and the supporting technical services\textsuperscript{[15]}.

**Exploration**

According to the Mines and Minerals Act with respect to petroleum and natural gas, exploration is any operation on or over land or water to determine geologic conditions underlying the surface of land or water. The exploration works of bitumen involve seismic surveys, boreholes and coreholes drilling, sampling and sample analysis, surface and subsurface mapping, pilot plant design, construction and operation, environmental baseline studies and environmental impact assessment, techno-economic analysis/feasibility report. Some of the environmental issues at this stage include:

a) Noise pollution from low-flying aircrafts
b) Ecosystem disturbance through drilling activities, access roads construction and human interference in otherwise purely wildlife habitats
c) Damages to farmlands and economic trees through drilling and construction works
d) Invasion of areas of cultural and traditional importance.

It is pertinent and mandatory therefore, to carry out Environmental Baseline Studies (EBS) and Environmental Impact Assessment (EIA) before certain exploratory works such as extensive drilling programmes and prolonged pilot plant operations are embarked upon.
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**Bitumen Recovery**

There are different methods of bitumen recovery depending mainly on the depth of occurrence. Some methods are applicable over overlapping depth ranges. Other factors that can also influence the choice of one method over a close substitute are economics, environmental considerations and government regulations. The recovery methods can be generally grouped into two broad categories: open cast mining and in-situ recovery.

**Open Cast Mining Method**

Open cast mining is mostly used for bitumen occurrence close to the earth surface, at depths ranging from 0 – 50m. This involves the removal of the top soil (also referred to as overburden) to gain access to the underlying bitumen. This method involves the use of very heavy machinery and equipment such as excavators, bulldozers, large tippers, long-span draglines, etc. Some of the environmental concerns associated with this method include:

- a) Air pollution from fumes, dusts and gaseous emissions
- b) Noise from the machines and excavation works which may involve the use of explosives
- c) Displacement of communities to make ways for mines
- d) Disturbance of ecosystems
- e) Destruction of farmlands and other economic trees during the development of mines and the disposal of debris or overburden, construction of roads, piles and mine camps
- f) Increased human population putting pressure on infrastructural facilities
- g) Erosion due to mined out lands requiring reclamation
- h) Acid rain phenomena due to dissolution of emitted gases

**In-Site Mining Method**

In-situ recovery methods are used where bitumen occurs at depths lower than those suitable for open cast. They are more environmental friendly than open cast mining because they allow the recovery of bitumen with little or no disturbance to the topsoil and vegetation. In addition, the machinery and equipment employed are generally not trans-mobile. Some of the in-situ methods include: the steam methods, in-situ combustion, gravity drainage methods, horizontal drilling, etc. The use of the in-situ methods marks the point from which similarities begin to occur between the light oil and bitumen processes. Except for the displacements issues and dusts impacts, most of the other environmental issues identified in the open cast method can be associated with the in-situ methods in addition to possible spillages from the pressurized wells, disposal of drilling mud, ditch cuttings, likely land faults, collapse of bridges and buildings due to changes in subsurface structures occasioned by underground drilling.

**Extraction and Upgrading**

Extraction involves the separation of the bitumen from the physical impurities, which are mainly sand, pebbles and rocks. Others are fossils,
other organic matters and minerals depending on the reservoir geology. Several equipments such as flood ports, troughs, pipes, whirlpools, decanters, filters and heat exchanger are employed at various stages to remove the different kinds of impurities. Environmental issues associated with this stage arise from construction of long distance pipelines, erection of the separation facilities, spillages, heat escaping from exchangers and disposal of the impurities. Upgrading involves the treatment of the extracted bitumen or heavy oil, usually by the addition of diluents (such as gas condensates) to improve some of the oil’s undesirable qualities which are: high acid content, low gravity and high residue content. Another upgrading process is cooking which requires more heat input than the addition of diluents and also produces more air pollutants. Further processing of the upgraded or diluted oil will involve refining (as in conventional oil) employing from the simple hydro-skimmer type refineries to the more complex catalytic crackers to obtain products like the light hydrocarbon gases, (methane and ethane); liquefied petroleum gases (propane and butane); the liquid (DPK, PMS and AGO), fuel oils, sulphur, coke and asphalt. It is obvious that the environmental concerns at this stage are similar to those in conventional refineries. These include:

a) Spillage
b) Fumes and other gaseous emissions
c) Noise and vibrations
d) Displacements and eco-disturbances from roads, pipeline and reservoir constructions and increased human and vehicular traffic
e) Surface water and shallow ground water (aquifers) contamination by waste water and effluent discharges

Storage, Transportation and Utilities

Recovered bitumen requires space for storage mostly in the stacks and piles with all the environmental issues associated with space creation. Transportation of bitumen involves very heavy duty trucks, large conveyor belts and troughs or pipes. Utilities are integral parts of practically every stage in the bitumen process. Electricity needs to be generated for mine sites and mine camps. Water is necessary for several processes such as slurring, washing, sparging, etc. Steam from boilers is necessary to power some of the machines, for use in heat exchangers and more importantly for the steam recovery methods. Environmental and health hazards associated with these stages are similar to those in the core processes with the additional higher tendencies for explosions.
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**Photo Speak from the Bitumen Communities in Ondo State**

![Map showing Bitumen Deposit in Ondo State](image)

**Figure 1**: Map showing Bitumen Deposit in Ondo State

**Source**: Adegoke, T.A. (1980)

![Plate 1: Liquid and Semi Liquid Bitumen in Mile 2 at Agbabu](image)

**Plate 1**: Liquid and Semi Liquid Bitumen in Mile 2 at Agbabu
Plate 2: Bitumen Deposit in Agbabu

Plate 3: Tar Sand Deposit in Ajagba Community

Plate 4: Major Spill into Akingboju and Ofo Shuohu River of Diluted Bitumen
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Plate 5: Bitumen Transporting Pipeline and Polluted Site in One of the Communities in Ondo State

Plate 6: Bird and Aquatic Animals Killed by bitumen

Bitumen Exploitation and the Environmental Impact Assessment (EIA)
Factors to be considered and procedures for carrying out the EIA are contained in the procedural guidelines published by the Federal Environmental Protection Agency of the Federal Ministry of Environment which is empowered by the Federal Government of Nigeria and charged with the responsibility for the protection and development of the Nigerian environment including policy initiation in relation to environmental research and technology. The EIA Decree of 1992 gives legal muscle for the enforcement of the various provisions contained in the National Policy on Environment (1989) on the need for studies on the environmental impacts
of projects and processes at planning stages. There are specific guidelines for the different sectors of the economy such as infrastructure, agriculture and rural development, oil and gas, mining and manufacturing. By classification, the bitumen sector, governed by the Ministry of Solid Minerals Development should operate according to the mining sectoral guidelines. However, because of extensive operational similarities and confluences with crude oil, it is probable that in practice, the EIA in the bitumen sector will be straddled between both the mining and the oil and gas sectoral guidelines depending on the stage of operations\(^5\). It is also very probable that as the bitumen sector develops, there may be a need in the near future for bitumen sectoral guidelines for seamless processes and to also cater for peculiarities that may come up in the sector. Whichever guidelines are used, the operators and companies must ensure that they design and carry out the EIA in a manner that will achieve the basic objectives of:

a) Predicting the nature and magnitude of their proposed actions and effects
b) Identifying and assessing the physical, biological, socio-economic and cultural effects in a form that permits a logical and rational decision to be made
c) Documenting the indicators to be used in assessing the impact
d) Helping in the identification of possible alternative sites and/or processes
e) Giving confidence to the planning system by providing for public participation and/or consultation processes

Given the fact that the bitumen industry is at a nascent stage, it is strongly recommended that regular and consistent environmental monitoring, environmental evaluation and environmental auditing be conducted to ensure that the mitigation and remediation measures are adequately taken and regularly updated. Notwithstanding, some of the negative environmental effects on land, water and air, it is important to also highlight a few of the positive socio-economic impacts of resource exploitation which include the following:

a) Commodities for trade and raw materials for industries
b) Employment opportunities, especially in remote areas
c) Development of infrastructural facilities - schools, electricity, road, etc.
d) Opening up of remote mineral - rich areas to development
e) Facilitating foreign direct investments
f) Vertical and lateral demand linkages in the economy

The gains could transform the current state of the communities if properly harnessed

**Conclusion**

In conclusion, we wish to remind all that the Nigerian bitumen industry as we are probably aware, is just evolving. As a result, most of the concepts for its development, even
though they are scientific principles proven in other parts of the world, have not been fully tested here in Nigeria. We would therefore encourage all Nigerians and other stakeholders to make reasonable allowances for the successful adaptation of these technologies and methods for the efficient development of Nigeria’s bitumen resources and growth of the industry. It is not late to adopt a people-oriented approach to bitumen exploitation in the bitumen rich communities to avoid resource conflicts and disaffection. The objective of this effort is to:

- Bring together all the stakeholders in the bitumen project: the host communities, the licensed firms, civil society organizations and the regulatory government agency to discuss ways to sustainable exploitation of the resource. The conference is therefore expected to come out clearly on the rights and responsibilities of all stakeholders so as to avoid duplicating what obtains in the Niger Delta;
- Encourage the Ministry of Environment to conduct a comprehensive social impact study and an Environment Impact Assessment (EIA) so as to ascertain the impact of the project on the local communities and their sources of livelihood;
- Urge the Federal Government and the bitumen firms to encourage the involvement and participation of the local communities in the project so as to ensure environmental justice and poverty reduction;
- Request the Federal Government and the bitumen firms to employ dialogue and the bottom-up development approach rather than the top-down approach in its dealings with the local communities.

The adoption of community based-natural resources management is recommended. It is an approach that recognizes the indispensable ownership and role of local communities in the exploitation, utilization and development of natural resources.

References


Environment Impact Assessment Act 1992 – Section 1(a)


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http://allafrica.com/stories/201003290824.html
